TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 USC 371

International Application No.:	PCT/RU98/00347
International Filing Date:	October 26, 1998
Priority Date Claimed:	October 27, 1997 and December 31, 1997
Title of Invention:	CATHODOLUMINESCENT SCREEN WITH A COLUMNAR STRUCTURE, AND THE METHOD FOR ITS PREPARATION
Applicant(s) for DO/EO/US:	Evgeny Invievich Givargizov, Ljudmila Alexandrovna Zadorozhnaya, Alla Nikolaevna Stepanova, Naum Petrovich Soshchin, Nikolai Nikolaevich Chubun and Mikhail Evgenievich Givargizov

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. (X) This is a **FIRST** submission of items concerning a filing under 35 USC 371.

2. ( ) This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 USC 371.

3. (X) This express request to begin national examination procedures (35 USC 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 USC 371(b) and PCT Articles 22 and 39(1).

4. (X) A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

5. (X) A copy of the International Application as filed (35 USC 371(c)(2))

   a) ( ) is transmitted herewith (required only if not transmitted by the International Bureau).
   b) (X) has been transmitted by the International Bureau.
   c) ( ) is not required, as the application was filed in the United States Receiving Office (RO/US).

6. (X) A translation of the International Application, as amended during the International Preliminary Examination, into English (35 USC 371(c)(2)).

7. (X) Amendments to the claims of the International Application under PCT Article 19 (35 USC 371(c)(3))

   a) ( ) are transmitted herewith (required only if not transmitted by the International Bureau).
   b) ( ) have been transmitted by the International Bureau.
   c) ( ) have not been made; however, the time limit for making such amendments has NOT expired.
   d) (X) have not been made and will not be made.

8. ( ) A translation of the amendments to the claims under PCT Article 19 (35 USC 371(c)(3)).

9. ( ) An oath or declaration of the inventor(s) (35 USC 371(c)(4)).

10. ( ) A copy of the International Preliminary Examination Report with any annexes thereto, such as any amendments made under PCT Article 34.

11. ( ) A translation of the annexes, such as any amendments made under PCT Article 34, to the International Preliminary Examination Report under PCT Article 36 (35 USC 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

12. ( ) An Information Disclosure Statement under 37 CFR 1.97 and 1.98.

13. ( ) An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.

14. (X) A FIRST preliminary amendment.
( ) A SECOND or SUBSEQUENT preliminary amendment.

15. ( ) A substitute specification.

16. ( ) A power of attorney and/or address letter.

17. (X) International Application as published (cover sheet).

18. ( ) Small Entity Statement.

19. ( ) PCT Form PCT/IPEA/402.

20. ( ) PCT Form PCT/IB/308.

21. ( ) PCT request form.

22. (X) A return prepaid postcard.

23. (X) The following fees are submitted:

				FEES
	BASIC FEE			$840
CLAIMS	**NUMBER FILED**	**NUMBER EXTRA**	**RATE**	
Total Claims	16 - 20 =	0 ×	$18	$0
Independent Claims	3 - 3 =	0 ×	$78	$0
Multiple dependent claims(s) (if applicable)			$260	$0
	TOTAL OF ABOVE CALCULATIONS		$840	
Reduction by 1/2 for filing by small entity (if applicable). Verified Small Entity statement must also be filed. (NOTE 37 CFR 1.9, 1.27, 1.28)			$840	
	TOTAL NATIONAL FEE			$840
	TOTAL FEES ENCLOSED			$840
		amount to be refunded:		$0
		amount to be charged:		$0

24. (X) The fee for later submission of the signed oath or declaration set forth in 37 CFR 1.492(e) will be paid upon submission of the declaration.

25. (X) A check in the amount of $840 to cover the above fees is enclosed.

26. ( ) Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40 per property.

27. (X) The Commissioner is hereby authorized to charge only those additional fees which may be required, now or in the future, to avoid abandonment of the application, or credit any overpayment to Deposit Account No. 11-1410. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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Assistant Commissioner for Patents
Washington, D.C. 20231

CERTIFICATE OF MAILING BY "EXPRESS MAIL"

Attorney Docket No.	:	GIVAR4.001APC
Applicant(s)	:	Givargizov, et al.
For	:	CATHODOLUMINESCENT SCREEN WITH A COLUMNAR STRUCTURE, AND THE METHOD FOR ITS PREPARATION
Attorney	:	John M. Carson
"Express Mail" Mailing Label No.	:	EL531038490US
Date of Deposit	:	April 27, 2000

I hereby certify that the accompanying

Transmittal in Duplicate; Specification in 10 pages; 5 sheets of drawings; Preliminary Amendment in 3 pages; International Application as published (cover sheet); Check for Filing Fee; Return Prepaid Postcard.

are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and are addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

John Riedel

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	:	Givargizov, et al.	Group Art Unit Unknown
Appl. No.	:	Unknown	
Filed	:	Herewith	
For	:	CATHODOLUMINESCENT SCREEN WITH A COLUMNAR STRUCTURE, AND THE METHOD FOR ITS PREPARATION	
Examiner	:	Unknown	

I hereby certify that this correspondence and all marked attachments are being deposited with the United States Postal Service as first-class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231, on

April 27, 2000
(Date)

John M. Carson, Reg. No. 34,303

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Prior to examination of the above-captioned application, please amend the application as follows:

IN THE SPECIFICATION:

On page 1, line 5, please replace "PRIOR ART" with "BACKGROUND OF THE INVENTION."

On page 1, line 8 below, please replace "the patent [1]," with --EP-A-232 586--.

On page 1, line 3 below, please replace "Another patent [2]," with --EP-A-170 310--.

On page 2, line 6 top, please replace "the patent [3]," with --EP-062 993--.

On page 2, line 11 and line 15 top, please replace "the patent [4]," with --JP 55088245--.

On page 2, line 15 top, please replace "patent [4]," with --JP 55088245--.

On page 3, line 15 below, please replace "BEST VERSION FOR REALIZATION OF THE INVENTION" with --DETAILED DESCRIPTION OF CERTAIN EMBODIMENTS OF THE INVENTION.—

Please delete page 7.

On page 8, please replace "CLAIMS" with --WHAT IS CLAIMED IS:--

IN THE CLAIMS:

Please cancel Claims 2-14 without prejudice.

Please add new Claims 15-29 as follows:

15. A cathodoluminescent mosaic screen on a light-transparent substrate, comprising light-emitting, light-guiding, dielectric, and electroconductive light-absorbing components, the light-emitting components being implemented as columnar crystals, wherein each column is surrounded by a gap coaxial to the column, the gaps are filled by an electroconductive non-light-emitting medium.

16. The screen according to Claim 15, wherein outer butt-ends of the columns are coated by a light-emitting luminescent layer whose thickness is smaller than a height of the columns for at least an order of magnitude.

17. The screen according to Claim 16, wherein the luminescent layer is epitaxial in respect to the columns.

18. A method for preparation of luminescent screens consisting of single-crystalline columns on substrates by vapor deposition of luminescent material wherein an intermediate substance forming a liquid phase at the crystallization temperature, other than the luminescent material, is first deposited on the substrate and, then, the luminescent material is deposited on such a substrate.

19. The method according to Claim 18, wherein a thickness of the intermediate substance is more than 10 nanometers and smaller than 1 micrometer.

20. The method according to Claim 18, wherein the liquid phase is formed at a contact interaction of the intermediate substance with the substrate.

21. The method according to Claim 18, wherein the intermediate substance is formed by more than one chemical elements.

22. The method according to Claim 19, wherein the intermediate substance is formed by more than one chemical elements.

23. The method according to Claim 21, wherein at least one of the chemical elements is operating as a luminescent activator or co-activator.

24. The method according to Claim 18, wherein a microrelief of inhomogenities in at least one of structure and chemical composition is crated on the substrate.

25. The method according to Claim 24, wherein the inhomogenities are of a regular character.

26. The method according to Claim 25, wherein the inhomogenities have crystallographically-symmetric character.

27. The method according to Claim 18, wherein the activator or co-activator is introduced into the luminescent material by means of ion implanation.

28. The method according to Claim 26, wherein the luminescent material is coated by a thin layer of a material transparent for passing through it of electrons.

29. The method according to Claim 28, wherein diamond or diamond-like material serve as the transparent material.

REMARKS

The foregoing amendments are to more closely conform the application to U.S. practice. No new matter is added. Entry of the amendments is respectfully requested.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: 4/27/00

By: _____

John M. Carson
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VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL-ENTITY STATUS

1. I, the undersigned, do hereby declare that:

a. [X] I am an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees to the Patent and Trademark Office with regard to the invention described in the patent or application identified above; OR

b. [ ] While I am not an inventor, I declare that rights under contract or law have been conveyed to and remain with me with regard to the invention described in the patent or application identified above. I would qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying fees to the United States Patent and Trademark Office if I had made the invention; OR

c. [ ] I am the owner of the small business concern identified below OR
[ ] I am an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF SMALL BUSINESS: _____
ADDRESS OF SMALL BUSINESS: _____

If either of the boxes in item (c) is checked, I further declare that the above-identified small business concern qualifies as a small business concern as defined in 13 CFR 121.1301 through 121.1305, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees to the United States Patent and Trademark Office, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both. I further declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention described in the patent or application identified above; OR

d. [ ] I am an official empowered to act on behalf of the nonprofit organization identified below:

NAME OF NONPROFIT ORGANIZATION:
ADDRESS OF NONPROFIT ORGANIZATION:
TYPE OF NONPROFIT ORGANIZATION:

[ ] university or other institution of higher education; OR
[ ] tax exempt under Internal Revenue Service Code (26 USC 501(a) and 501(c)(3)); OR
[ ] nonprofit scientific or educational organization qualified under a nonprofit organization statute under a statute of a state of the United States of America
(name of state: _____)
(citation of statute: _____); OR
[ ] would qualify as tax exempt under Internal Revenue Service Code (26 USC 501(a) and 501(c)(3)) if located in the United States of America; OR
[ ] would qualify as nonprofit scientific or educational organization qualified under a nonprofit organization statute under a statute of a state of the United States of America if located in the United States of America
(name of state: _____)
(citation of statute: _____)

If Box (d) is checked, I further declare that the nonprofit organization identified above qualifies as a nonprofit organization as defined in 37 CFR 1.9(c) for purposes of paying reduced fees to the United States

Patent and Trademark Office regarding the invention described in the patent or application identified above.

2. The individual, concern or organization identified above has not assigned, granted, conveyed or licensed, and is under no obligation under contract or law to assign, grant, convey or license, any rights in the invention to any person who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

3. If the rights held by the above-identified individual, concern or organization are not exclusive, each individual, concern or organization having rights in the invention are identified below. Each such individual, concern or organization must file separate verified statements averring to their status as small entities.

***NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27).**

FULL NAME: _____
ADDRESS: _____
[ ] INDIVIDUAL [ ] SMALL BUSINESS CONCERN [ ] NONPROFIT ORGANIZATION

FULL NAME: _____
ADDRESS: _____
[ ] INDIVIDUAL [ ] SMALL BUSINESS CONCERN [ ] NONPROFIT ORGANIZATION

4. I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small-entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b)).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

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Name of person signing: Ljudmila Alexandrovna Zadorozhnaya
Inventor's signature _____ Dated: April 07, 2000
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PCT/RU 98/00347
27 January 2000 (27.01.2000)

CATHODOLUMINESCENT SCREEN WITH A COLUMNAR STRUCTURE, AND THE METHOD FOR ITS PREPARATION

E.I.Givargizov, L.A.Zadorozhnaya, A.N.Stepanova, N.P.Soshchin, N.N.Chubun, and M.E.Givargizov

FIELD OF THE INVENTION

The present invention relates to the area of electronic materials and to microelectronics, including vacuum microelectronics, in particular to devices based on field emission, such as field-emission displays, vacuum fluorescent displays, cathodeluminescent lamps, etc.

PRIOR ART

The existing luminescent screens are produced, as a rule, in the shape of crystalline films that are prepared, for example, by deposition from a vapor phase onto smooth, for example, glass substrate.

For the deposition, techniques of evaporation of materials in vacuum, of sublimation, of chemical transport, of cathode sputtering, etc, are used.

In all the techniques, the nucleation of the crystalline luminescent materials (phosphors) occurs in a non-controlling manner, homogenously or heterogeneously, on a smooth structure-less substrate . At that case, the phosphors are usually a collection of tiny (micron and/or submicron) crystalline grains, usually isometric, approximately spherical shape superposed one onto another (Fig. 1). In such a system, the light generated in a crystalline grain (i.e., designated by a cross) is repeatedly scattered in the labyrinth of surrounding phosphor grains. This phenomenon deteriorates the resolution of the screen.

One more problem relates to the fact that in the film screen, consisting of the crystalline grains, do not all the space is filled by the phosphor. This decreases the effectivity of the screen and deteriorates its thermo- and electroconductivity.

In addition, such screens have a bad adgesion to substrates because the approximately-spherical crystalline grains have only point contacts with the substrates.

In the patent [1], single-crystalline (plate-like or epitaxial-layer) materials are used as phosphors. This improves reproducibility of characteristics of the screen and increases its effectivity (the ratio of the light energy to the energy expended for the light excitation). However, at such a case, the emitting light propagates along the plate (or along the epitaxial layer) of the phosphor; this deteriorates the resolution and the effectivity of the screen.

Another patent [2] supposes localized deposition of a phosphor from a diluted solution or suspension by spinning into holes, side walls of the holes being metallized in order to exclude penetration of the light into neighbor areas of the luminescent scren. However, at this case,

contrast of the image is increased for only 50%; in other words, scattering of the light along the luminescent screen is not excluded.

These drawbacks can be eliminated if the luminescent screen is made of columnar crystallites that have elongated shape whose elongation direction is approximately perpendicular to the plane of the screen. Such an idea is realized in the design described in the patent [3]. At such a case the light excitated at columnar crystallites of the phosphor propagates in the elongation direction of the crystallites, the crystallites being acting as light-guides. However, the method for preparation of such screens by melt crystallization is not suitable for many practically-important cases, e.g., for thin (0.1 - 1 micrometer thickness) flat luminescent screen used in field-emission displays.

In the patent [4], a screen with columnar crystals has been proposed where an insert of non-luminous black material adjacent to the columnar crystals was placed. Such an insert is able to increase an image contrast of the columns that are directly adjacent to the insert, while other columns that are not adjacent (are not contacted) to the insert are not able to increase their contrast. In addition, patent [4] does not give a method for preparation of such a screen.

In this invention, a more optimized design of the screen is proposed. In addition, a technology for preparation of the screen is proposed.

SUMMARY OF THE INVENTION

A screen with columnar structure is proposed where each column is surrounded by a gap coaxial to the column, the gaps are filled by an electroconductive non-light-emitting medium. Outer butt-ends of the columns are coated by a light-emitting luminescent layer, thickness of the layer being smaller than height of the columns for at least one order of magnitude. The luminescent layer can be epitaxial in respect to the columns.

A method for preparation of the luminscent screens is proposed in this invention, too. The method consists in vapor deposition of the luminescent material where an intermediate substance, that is other than the luminescent material and that forms a liquid phase at the crystallization temperature, is firstly deposited on the substrate. After that, the luminescent material is deposited on such a substrate. Thickness of the intermediate substance is more than 10 nanometers and smaller than 1 micrometer. The liquid phase is formed at a contact interaction of the intermediate substance with the substrate.

The intermediate substance is formed by more than one chemical elements. At least one of the chemical element is operating as an luminescent activator or co-activator. The activator or co-activator is introduced into the luminescent material by means of ion implantation.

A microrelief of inhomogenities in structure and/or chemical composition is created on the substrate, the inhomogenities being of regular character, in particular, of crystallographically-symmetric character.IPEA/RU

The luminescent material is coated by a thin layer of a material that is transparent for electrons. In particular, diamond or diamond-like material serve as the transparent material.

A BRIEF DESCRIPTION OF THE FIGURES

Fig. 1. A scheme of a standard cathodoluminescent screen that is formed by a film of approximately isometric crystalline grain.

Fig.2. A scheme of a cathodoluminescent screen formed by a film, that consists of columns approximately perpendicular to substrate.

Fig. 3. A scheme of propagation of light beams in the film shown in Fig. 2.

Fig. 4. A SEM micrograph of a cleavage cross-section of a continuous film consisting of the columns.

Fig. 5. A scheme of the cathodoluminescent screen with columnar structure that is bombarded by electrons. The shaded upper parts of the columns show level to which the electrons penetrate and where the light is excited.

Fig. 6. A scheme of the cathodoluminescent screen. The upper butt-ends of the screen are coated by a light-emitting luminescent layer.

Fig. 7. A scheme of the cathodoluminescent screen formed of columns with gaps between them.

Fig. 8. A SEM micrograph of the film that consists of columns with gaps between them (top view). The mosaic structure of the screen is seen.

Fig. 9. A scheme of the cathodoluminescent screen shown in Figs. 7 and 8. The gaps are filled with an electroconductive non-emitting medium.

BEST VERSION FOR THE REALIZATION OF THE INVENTION

The cathodoluminescent screen with columnar structure, as it was proposed at the prior art, is illustrated in Figs. 2 and 3.

The cathodoluminescent screen, as it is proposed here, is illustrated in Figs. 4 to 9.

Typical height of the columns, as it is shown in Fig. 4, is about 5 micrometers. Typical height-to-diameter ratio of the columns ranges from 1:1 to 100:1.

An accelerated electron beam from a flat cathode, as it is usually considered in field-emission displays, is incident on the screen and penetrates into a surface layer (Fig. 5). At typical acceleration voltages of the field-emission displays (for example, 1 to 3 kV) the penetration thickness is about 100 nanometers (shown schematically in Fig. 5 as a shadowed layer). Accordingly, it is proposed to implement the screen as a columnar structure coated by a light-emitting luminescent layer (shown in Fig. 6).

The columns are surrounded by gaps ("trenches") coaxial to the columns. An elongated cross-section scheme of the columnar structure is shown in Fig. 7. A corresponding scanning electron micrograph of the screen (top-view) is shown in Fig. 8. As is seen, the columns are

surrounded by gaps ("trenches"). The gaps are filled by an electroconductive non-light-emitting medium has the coefficient of light absorption in respect to the emitting light more than 20%. A scheme of the filled screen is shown in Fig. 9. The filling ensures a conductivity of the screen and, in such a way, excludes charging phenomena when the luminescent screen is working in a cathodoluminescent mode.

These screens are featured by some advantages, especially in respect to low-voltage field-emission displays.

1. By a high light and energetic output that is caused by its design. Owing to the total internal reflection from the walls of the columns, a light-guide effect takes place: the light propagates preferentially along the columns, do not passing beyond columns and do not passing into neighbour columns.

2. By a low light scattering during the light propagation along the columns. This determines a high resolution of the design. It is equal to the number of the light-emitting components per a length unit.

3. By a high adgesion to the transparent substrate, to which the columns are fixed by their butt-ends, i.e., the light-emitting components contact to the substrate by a large area. This is especially important for diode-type field-emission displays where large gradients of the electric field are able to break screen particles off the substrate.

The advantages of the cathodoluminescent screens having the columnar structure are realized here by a proposed technology for their production. The technology is based on chemical or physical vapor deposition, a participation of a liquid phase in the deposition process being of principal importance. An effectivity of the technology is illustrated in Fig. 4 where the columnar structure of the luminescent material cadmium sulphide is shown.

It is to underline principal idea of the proposed design of the cathodoluminscent screen: the propagation direction of light in each columnar component is paraxial (parallel) to the direction of the primary electron beam, that excites the light (see Fig. 3), whereas in the known (standard) screens, formed by superposition of approximately-isometric grains, the light excited by the cathodoluminescence can propagate not only paraxially with the electron beam but also perpendicularly to it, or in any arbitrary direction in respect to the electron beam (see Fig. 1).

As the design of the columnar screen was realized and used in concrete electron devices, some not-evident its advantages were found.

(a) Luminescence brightness of different grains (columns in this case) becomes more uniform. In the standard cathodoluminescent screens, the brightness of various grains differs significantly (up to 50% at distances 25-30 micrometers) due to differences in sizes of emitting grains; this deteriorates transfer and fixation of qualitative images.

(b) Electrical and heat power dissipation by the columnar phosphors increases significantly (5 to 10 times) in comparison with the standard cathodoluminescent screens.

(c) The "burning out" of the columnar screens at an unexpected switching off the electron beam scanning is practically eliminated. In the standard cathodoluminescent screens the power sufficient for irreversable burning out of the screens is usually 0.1 W/element (here the element is an image element, i.e., a pixel), whereas preliminary testings of the proposed columnar screen indicate to increase of the parameter up to 1 W/element (here the element is a column).

(d) The background image contrast at an illumination with intensive light sources (sun, electric lamp, etc) is increased. Standard cathodoluminescent screens have the contrast value $k = b_{image}/b < 5$, where b is the brightness of background, b_{image} is the brightness of the pixel. Testings of the screens based on the proposed columnar phosphors show the values $k > 10$ to 20.

A significant electric charge accumulated by standard screens is not completely removed even by metallic (for example, aluminium) coatings 0.1 – 0.5 μm in thickness that are usually formed on the surface of the standard cathodoluminescent screens. This manifests itself in numerous discharges that disturb a stable work of electron devices. The columns are surrounded by gaps coaxial to the columns (see Figs. 7 to 9). The remainder of the substrate area and all other volume of the screen are filled by an electroconductive non-light-emitting medium that has the coefficient of light absorption in respect to the emitting light more than 20 %.

It is to note that the above-mentioned advantages of the columnar screens manifest theyself both in experimental (10x10 mm) and consumer (25x25 or 75x75 mm) sizes of the screens. In other words, the unique parameters of the proposed structure do not depend on the sizes.

Changes of cross-sectional sizes of the light-emitting elements have been studied in respect to characteristics of the screens in general. At the cross-sectional size of the light-emitting elements about 1 μm and the pitch distance about 2 μm a light-emitting structure contained more than $2.5.10^7$ cm^{-2} light-emitting elements has been prepared. The parameters are superior in resolution respectively to all known screens. It has been also found that the columnar structures with pitches 20 μm, at a total number of the columns $2.5.10^5$ cm^{-2}, can have important applications as screens of electron-beam devices and of transducers.

The procedure for filling of the gaps around the columns with the electroconductive non-light-emitting medium consists in a dipping of the columnar structure into a melt of suitable oxides and/or sulphides. Another approach consists in impregnation of columnar structures in low-melting-point compounds. As such, not only oxides like B_2O_3 (melting point 450°C), V_2O_5 (melting point 670°C), CdO (826°C), PbO_2 (290°C), Bi_2O_3 (817°C), but also sulphides SnS (882°C), Sb_2S_3 (550°C) were used. In addition, metallic eutectics like Cd-Bi-Pb-Sn (melting point 65°C) and Pb-Sn were tested, too. All the mentioned compositions absorb the light in the spectral subrange 420 to 760 nanometers, therefore it is possible, in the mosaic columnar

structure, to increase significantly the contrast value owing to an increased absorption of the side emission of the columns and of an external light passing through the transparent substrate.

It was studied an influence of the electroconductive medium on the luminescent properties of the screen formed by the mosaic columnar structure. In the case of the filling of the gaps between the columns by the eutectic metallic phase Cd-Bi-Pb-Sn, the resistivity of the filling phase was 1 to 20 Ohm.cm at the value of the optical absorption > 10^5 cm^{-1}. At the ratio of the substrate area, coated by the columns, to the area of the filling medium 5:1, the coefficient of light reflection from the front surface of the screen is 20%, while a similar columnar structure, that was not filled by the electroconductive medium, reflects 45 to 60% of incident light.

Relationships between the height of the columns and the height level of the light-absorbing phase were not studied. In some preliminary experiments, the relationship was 2:1. Even such a value provided run-off the electron current densities 1 to 10 A/cm^2.

The columnar elements of the mosaic screen can have an additional coating by metallic (Al or Ag) mirror transparent for electron beams with energies > 5 keV.

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3. B. Cockayne, Cathode ray tube phosphor layers, European Patent Application 062993, Cl. H01 J 29/20 (1982).

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CLAIMS

1. A cathodoluminescent mosaic screen on a light-transparent substrate that (screen) contains light-emitting, light-guiding, dielectric, and electroconductive light-absorbing components, the light-emitting components being implemented as columnar crystals, **wherein** each column is surrounded by a gap coaxial to the column, all the gaps are filled by an electroconductive non-light-emitting medium that has a coeffiecient of light absorption in respect to the emitting light more 20%.

2. The screen according to the claim 1 **wherein** outer butt-ends of the columns are coated by a light-emitting luminescent layer whose thickness is smaller than height of the columns for at least an order of magnitude.

3. The screen according to the claim 2 **wherein** the luminescent layer is epitaxial in respect to the columns.

4. A method for preparation of luminescent screens consisting of single-crystalline columns on substrates by vapor deposition of luminescent material **wherein** an intermediate substance forming a liquid phase at the crystallization temperature, other than the luminescent material, is firstly deposited on the substrate and, then, the luminescent material is deposited on such a substrate.

5. The method according to the claim 4 **wherein** the thickness of the intermediate substance is more than 10 nanometers and smaller than 1 micrometer.

6. The method according to the claim 4 **wherein** the liquid phase is formed at a contact interaction of the intermediate substance with the substrate.

7. The method according to any of claims 4 or 5 **wherein** the intermediate substance is formed by more than one chemical elements.

8. The method according to the claim 7 **wherein** at least one of the chemical element is operating as a luminescent activator or co-activator.

9. The method according to the claim 4 **wherein** a microrelief of inhomogenities in structure and/or in chemical composition is created on the substrate.

10. The method according to the claim 9 **wherein** the inhomogenities are of a regular character.

11. The method according to the claim 10 **wherein** the inhomogenities have crystallographically-symmetric character.

12. The method according to the claim of any of the claims 4 or 8 **wherein** the activator or co-activator is introduced into the luminescent material by means of ion implantation.

13. The method according to the claim 11 **wherein** the luminescent material is coated by a thin layer of a material transparent for passing through it of electrons.

14. The method according to the claim 13 **wherein** diamond or diamond-like material serve as the transparent material.

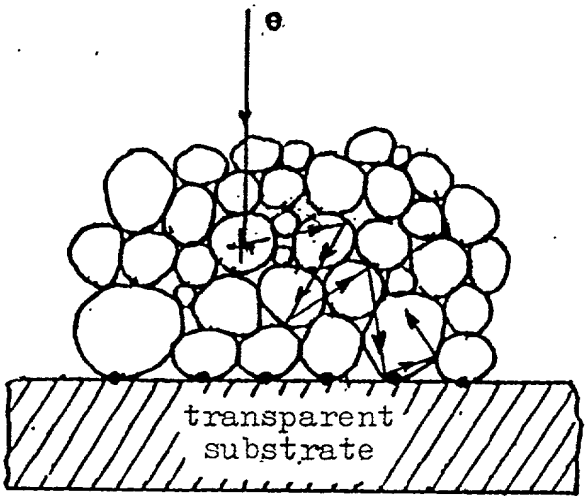


Fig. 1.

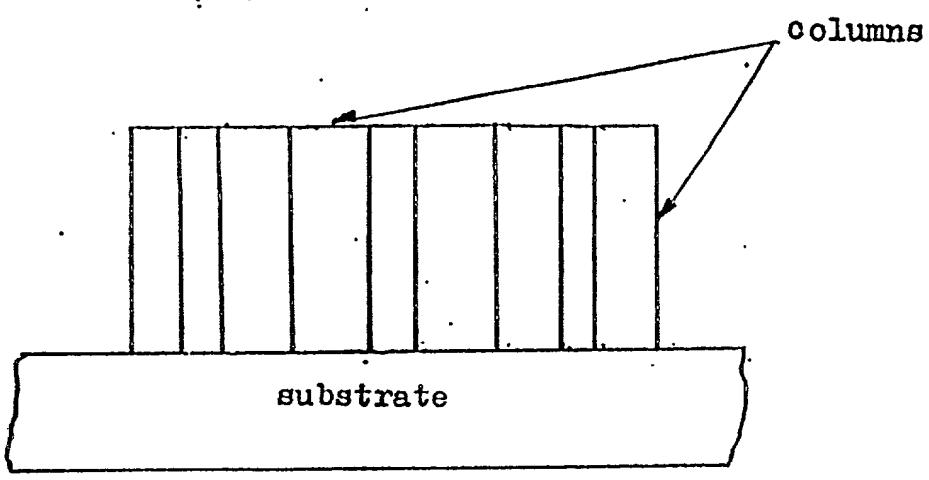
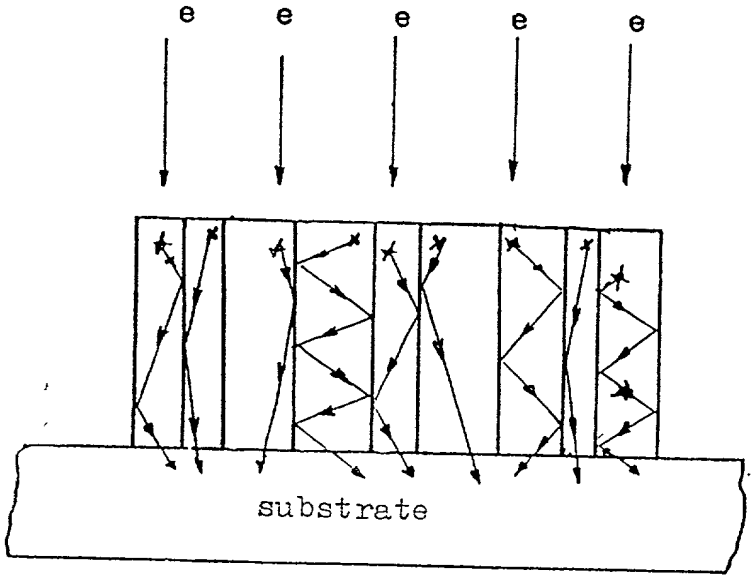


Fig. 2.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substrate

Fig. 3.

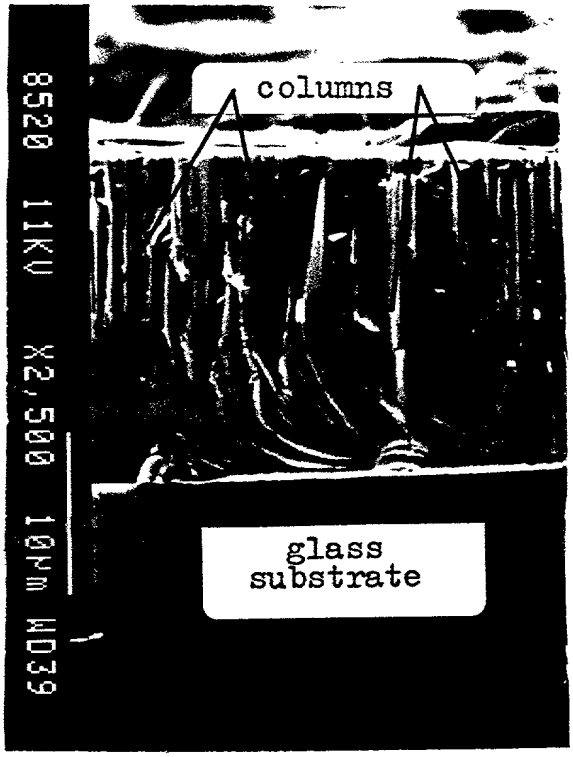
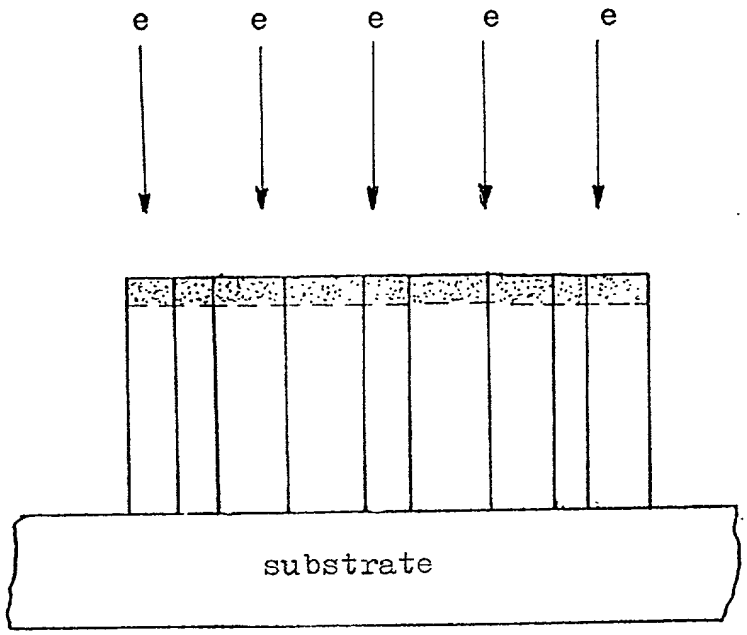

columns
glass
substrate
8520 11KV X2,500 10µm WD39

Fig. 4.


e
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substrate

Fig. 5.

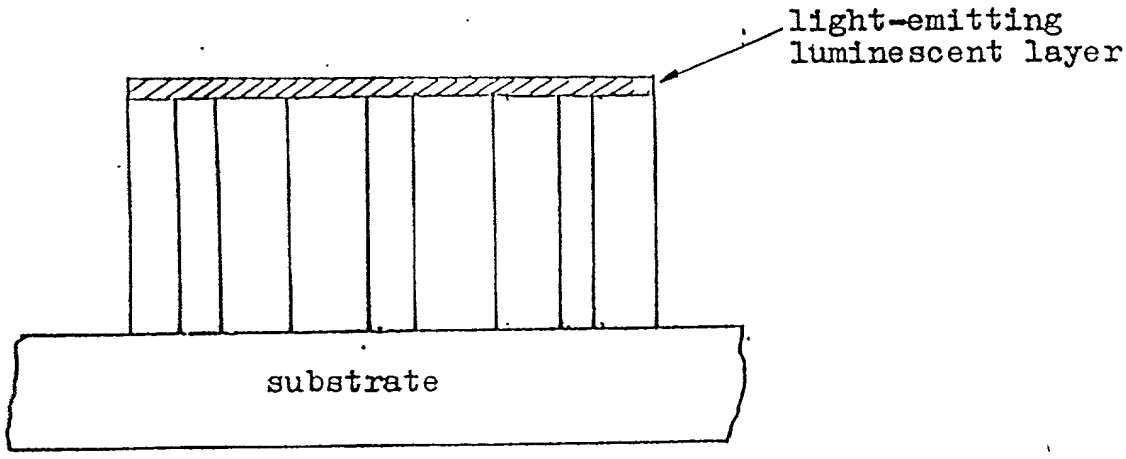
light-emitting
luminescent layer
substrate

Fig. 6.

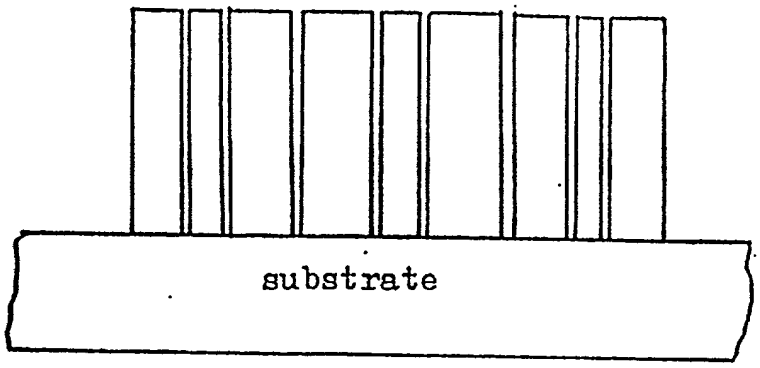

Fig. 7.

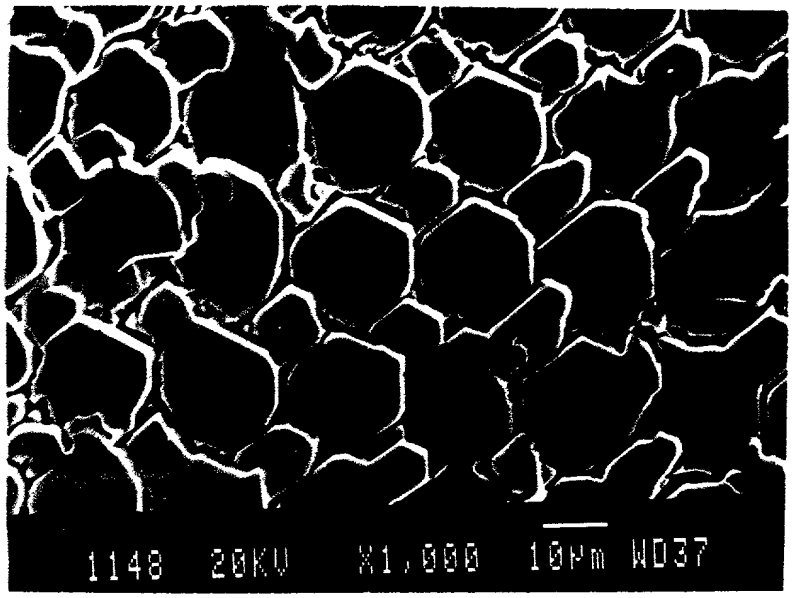

Fig. 8.

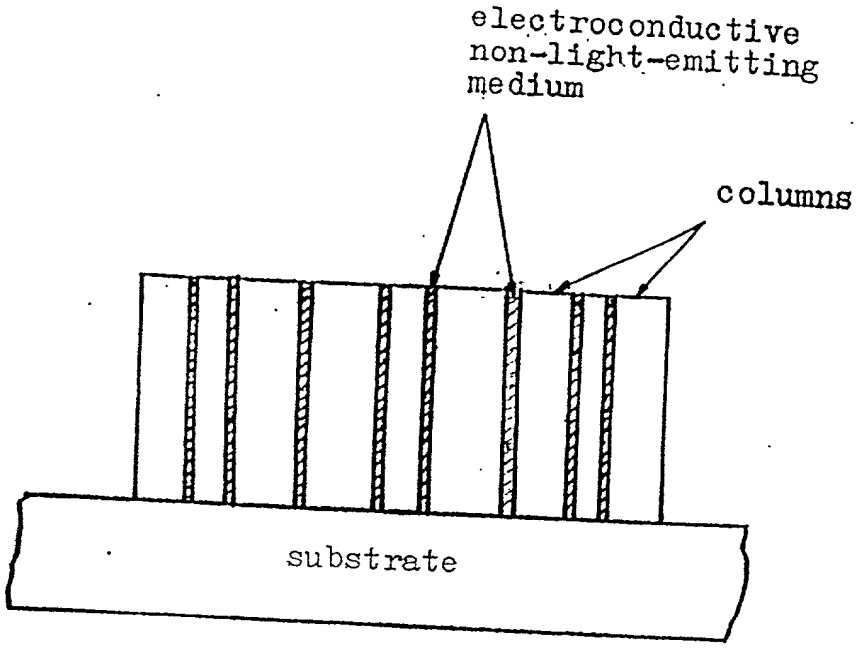
electroconductive
non-light-emitting
medium
columns
substrate

Fig. 9.

DECLARATION AND POWER OF ATTORNEY-USA PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled CATHODOLUMINESCENT SCREEN WITH A COLUMNAR STRUCTURE, AND THE METHOD FOR ITS PREPARATION the specification of which:

(a) ☐ is attached hereto; or

(b) ~~☒~~ was filed on 4/27/00 as Application No09/530,512 or

(c) X was described and claimed in PCT International Application No. PCT/RU98/00347 filed on October 26, 1998 and as amended under PCT Article 19 on _____ (if any) and/or under PCT Article 34 on _____ (if any).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above;

I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, § 1.56;

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent, design or inventor's certificate or any PCT international application(s) listed below and have also identified below any foreign application(s) for patent, design or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed for the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN APPLICATION(S)

COUNTRY (OR INDICATE IF PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 U.S.C. § 119	
Russia	97117737	27/10/97	X YES	NO ☐
Russia	97122024	31/12/97	X YES	NO ☐
			☐ YES	NO ☐
			☐ YES	NO ☐
			☐ YES	NO ☐

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below, and insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Prior U.S.A. Application(s)

Application No.: _____ Filing Date: _____ Status: _____

POWER OF ATTORNEY: I hereby appoint the registrants of Knobbe, Martens, Olson & Bear, LLP, 620 Newport Center Drive, Sixteenth Floor, Newport Beach, California 92660, Telephone (949) 760-0404, **Customer No. 20,995.**

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful, false statements may jeopardize the validity of the application or any patent issued thereon.

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